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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellants	:	Earl Ault	Docket No.	:	IL-10680
Serial No.	:	09/661,653	Art Unit	:	2828
Filed	:	9/14/2000	Examiner	:	Davienne N. Monbleau

Title : HIGH POWER LASER HAVING A TRIVALENT TITANIUM LIQUIT HOST

TRANSMITTAL OF BRIEF ON APPEAL (PATENT APPLICATION - 37 CFR 192)

Transmitted herewith in **triplicate** is the **BRIEF ON APPEAL** in this application with respect to the Notice of Appeal filed on October 6, 2003.

The item(s) checked below are appropriate:

1. **STATUS OF APPLICANT**
   This application is on behalf of
   - ☐ other than a small entity.
   - ■ a small entity.
     A verified statement
     - ☐ is attached
     - ■ already filed.

2. **FEE FOR FILING APPEAL BRIEF**
   Pursuant to 37 CFR 1.17(e) the fee for filing the Appeal Brief is:

■	small entity	$165.00
☐	other than a small entity	$330.00

Appeal Brief fee due **$165.00**

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on February 19, 2004

Kathy E. Raymond
Kathy E. Raymond

3. EXTENSION OF TIME

☐ Applicant petitions for an extension of time under 37 CFR 1.136

Calculation of extension fee (37 CFR 1.17(a)-(d)):

	Total months requested	Fee for other than small entity	Fee for small entity
☐	one month	$110.00	$55.00
☐	two month	$420.00	$210.00
☐	three month	$950.00	$475.00
☐	four month	$1,480.00	$740.00
☐	five month	$2,010.00	$1,005.00
		Fee	**$000.00**

4. FEE PAYMENT

- ■ Charge Account No. 12-0695 in the amount of **$165.00**.
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Eddie E. Scott

Eddie E. Scott
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Date: February 19, 2004

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant :	Earl Ault	Docket No. :	IL-10680
Serial No. :	09/661,653	Art Unit :	2828
Filed :	09/14/2000	Examiner :	Davienne N. Monbleau
For :	HIGH POWER LASER HAVING A TRIVALENT TITANIUM LIQUID HOST		

Honorable Commissioner for Patents
Alexandria, VA 22313-1450

Attention: Board of Patent Appeals and Interferences

Dear Sir:

APPELLANT'S BRIEF (37 C.F.R. § 1.192)

This brief is submitted in response to a Notification of Non-Compliance With 37 CFR 1.192 dated February 13, 2004 and in support of appellant's notice of appeal from the decision of the Examiner, mailed August 27, 2003, finally rejecting claims 1, 3, 4, 5, and 9 of the subject application. Appellant's notice of appeal was mailed October 6, 2003.

This brief is transmitted in triplicate per 37 C.F.R. § 1.192.

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TABLE OF CONTENTS

I. IDENTIFICATION OF THE REAL PARTY OF INTEREST

The real party in interest is:

The Regents of the University of California and the United States of America as represented by the United States Department of Energy (DOE) by virtue of an assignment by the inventor as duly recorded in the Assignment Branch of the U.S. Patent and Trademark Office.

II. IDENTIFICATION OF RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

III. STATUS OF ALL THE CLAIMS, PENDING OR CANCELLED, AND IDENTIFYING THE CLAIMS APPEALED

The application as originally filed contained claims 1-9.

Claims 2, 6, 7, and 8 were cancelled.

Claims 1, 3, 4, 5, and 9 stand rejected.

The claims on appeal are claims 1, 3, 4, 5, and 9..

The claims on appeal, claims 1, 3, 4, 5, and 9 are reproduced in Appendix A.

IV. STATUS OF ANY AMENDMENT FILED SUBSEQUENT TO FINAL REJECTION

There have been no amendments filed subsequent to the final rejection mailed August 27, 2003.

V. SUMMARY OF THE INVENTION

The invention as defined by the claims on appeal is shown in Drawing Figure 1, attached as Exhibit A, and is described in the specification as a closed loop circulation

system 21. The closed loop circulation system 21 circulates trivalent titanium ions dissolved in a liquid host through a first lasing chamber 22 in a first linear direction into a second lasing chamber 22.′ The trivalent titanium ions are circulated through the second lasing chamber 22′ in a second linear direction and back into the first lasing chamber 22. The second linear direction is opposite to the first linear direction. A pair of semiconductor pumping devices 23 and 23′are located within the lasing chambers 22 and 22′. The semiconductor pumping devices 23 and 23′ are used to optically excite the liquid lasing medium within the optical cavities, lasing chambers 22 and 22′. The elements of the claims on appeal are "read on" Applicants Specification and Drawings in the following table:

Claim 1	Appellant's Specification & Drawings
A laser, comprising: a laser cavity having a first lasing chamber, a second lasing chamber, trivalent titanium ions dissolved in a liquid host within said first lasing chamber, trivalent titanium ions dissolved in a liquid host within said second lasing chamber, a first semiconductor pumping device operatively connected to said first lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber, said first semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber, a second semiconductor pumping device operatively connected to said second lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said second lasing chamber, said second semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions dissolved in said liquid host within said lasing second chamber, a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host through said first lasing	"Referring now to the drawings and in particular to FIG. 1, an embodiment of a laser constructed in accordance with the present invention is illustrated. The laser system is generally designated by the reference numeral 20. A liquid lasing medium is circulated through a closed loop. The closed loop is generally designated by the reference numeral 21. The closed loop 21, filled with a Ti^{+3} bases liquid, circulates the liquid into and out of a pair of lasing chambers 22 and 22′. A pair of semiconductor pumping devices 23 and 23 ′ are located within the lasing chambers 22 and 22′. The semiconductor pumping devices 23 and 23′ are used to optically excite the liquid lasing medium within the optical cavities, lasing chambers 22 and 22′." (Appellant's Specification, Page 9, lines 3-12)

chamber in a first linear direction into said closed loop circulation system and into said second lasing chamber and through said second lasing chamber in a second linear direction into said closed loop circulation system and back into said first lasing chamber, said second linear direction being opposite to said first linear direction, said a closed loop circulation system comprising a first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said first lasing chamber in said first linear direction and a second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said second lasing chamber in said second direction that is opposite to said first linear direction.

Windows at each end of the channel define an excitation volume. Two gain blocks with opposite flow directions are used to compensate for the static optical wedge induced by fluid heating. The linear component, or optical wedge, that builds up in the liquid as it flows past the pump windows is predictable and steady. By arranging two cells in series in the laser cavity having opposite flow directions allows the wedge to be canceled.
(Appellant's Specification, Page 9, lines 17-22)

Claim 3

The laser of claim 1 wherein said closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host includes a pump and a heat exchanger.

Appellant's Specification & Drawings

The pump 24 circulates the lasing liquid through a pair of heat exchangers/flow conditioners 25 and 25', a static pressurizer 26, and the optical cavities 22 and 22'.
(Appellant's Specification, Page 9, lines 14-16)

Claim 4

The laser of claim 1, wherein thermally induced optical phase errors are produced by said a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host and wherein said first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said lasing chamber in a first direction and said second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out said lasing chamber in a second direction that is opposite to said first direction provides a system for correcting said thermally induced optical phase errors.

Appellant's Specification & Drawings

Windows at each end of the channel define an excitation volume. Two gain blocks with opposite flow directions are used to compensate for the static optical wedge induced by fluid heating. The linear component, or optical wedge, that builds up in the liquid as it flows past the pump windows is predictable and steady. By arranging two cells in series in the laser cavity having opposite flow directions allows the wedge to be canceled
(Appellant's Specification, Page 9, lines 17-22)

Claim 5

The laser system of claim 4, wherein said first portion for circulating said trivalent titanium ions dissolved in a liquid host

Appellant's Specification & Drawings

Referring now to the drawings and in particular to FIG. 1, an embodiment of a laser constructed in accordance with

includes a first flow channel and said second portion for circulating said trivalent titanium ions dissolved in a liquid host includes a second flow channel, said first flow channel and said second flow channel being of substantially equal length.

Claim 9

A laser, comprising:
an optical cavity having
a first lasing chamber and
a second lasing chamber,
a lasing liquid containing trivalent titanium ions dissolved in a liquid host within said first lasing chamber and said second lasing chamber,
a first semiconductor pumping device operatively connected to said first lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber, said first semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions in the 800 to 900 nm region,
a second semiconductor pumping device operatively connected to said second lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said second lasing chamber, said second semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium Ions in the 800 to 900 nm region,
a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host, said a closed loop circulation system comprising a first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said first lasing chamber in said first direction, and a second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said second lasing chamber in said second

the present invention is illustrated..... The closed loop 21, filled with a Ti^{+3} bases liquid, circulates the liquid into and out of a pair of lasing chambers 22 and 22'.
A pair of semiconductor pumping devices 23 and 23 ' are located within the lasing chambers 22 and and 22'."
(Appellant's Specification, Page 9, lines 3-7)

Appellant's Specification & Drawings

"Referring now to the drawings and in particular to FIG. 1, an embodiment of a laser constructed in accordance with the present invention is illustrated.
The laser system is generally designated by the reference numeral 20.
A liquid lasing medium is circulated through a closed loop. The closed loop is generally designated by the reference numeral 21.

The closed loop 21, filled with a Ti^{+3} bases liquid, circulates the liquid into and out of a pair of lasing chambers 22 and 22'.
A pair of semiconductor pumping devices 23 and 23 ' are located within the lasing chambers 22 and 22'.

The semiconductor pumping devices 23 and 23' are used to optically excite the liquid lasing medium within the optical cavities, lasing chambers 22 and 22'."
(Appellant's Specification, Page 9, lines 3-12)

The present invention utilizes trivalent titanium ions dissolved in a liquid host to provide powerful laser action in the 800 to 900 nm region.
(Appellant's Specification, Page 6, lines 3-5)

The pump 24 circulates the lasing liquid

direction that is opposite to said first direction, said closed loop circulation system including a pump and a heat exchanger.	through a pair of heat exchangers...... (Appellant's Specification, Page 9 lines 14-13)

VI. CONCISE STATEMENT OF THE ISSUE PRESENTED FOR REVIEW

Claims 1, 3, 4, 5, and 9 stand finally rejected under 35 U.S.C. §103(a) as allegedly being obvious over the combination of the Primary Kocher reference (U. S. Patent No. 3,663,891) and the Secondary Chun reference (U. S. Patent No. 4,654,855) and the Tertiary Scheps reference (U. S. Patent No. 5,307,358). It is Appellant's position that none of the three references used in the Office Action show certain significant elements of Appellant's rejected claims, and that it would not be obvious to combine the three references. The Kocher reference is a liquid laser, the Chun reference is a gas laser, and the Scheps reference is a solid state laser. Significant features from such different lasers can not be substituted from one reference to another.

The single issue presented for review is:

Whether it would be obvious to combine the Primary Kocher reference, the Secondary Chun reference, and the Tertiary Scheps reference to meet Appellant's apparatus claims 1, 3, 4, 5, and 9?

VII. GROUPING OF THE CLAIMS

Claims 1, 3, 4, 5, and 9 (all of the claims on appeal) are in one group. The single issue covers the claims in this group.

VIII. ARGUMENTS OF THE APPELLANT, WITH EACH ISSUE IN SEPARATE HEADINGS, WITH RESPECT TO EACH ISSUE PRESENTED FOR REVIEW

The Single Issue - Whether it would be obvious to combine the Primary Kocher reference, the Secondary Chun reference, and the Tertiary Scheps reference to meet Appellant's apparatus claims 1, 3, 4, 5, and 9?

The factual inquiries set forth in Graham v. John Deere Co., 383 U.S. 1, 148 USPQ 459 (1966) that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) include "2. Ascertaining the differences between the prior art and the claims at issue."

Appellants have identified differences between the cited prior art references and Appellant's claims 1, 3, 4, 5, and 9.

<u>Closed Loop Circulation System</u> - None of the cited prior art references show the claim elements of a closed loop circulation system that circulates the trivalent titanium liquid through said first lasing chamber in a first direction and through said second lasing chamber in a second direction that is opposite to said first direction.

The Primary Kocher reference does not show a liquid host flowing through said first lasing chamber in a first direction or flowing and through said second lasing chamber in a second direction. As clearly shown in Figure 1 of the Kocher reference and described in the Kocher reference specification, the Kocher fluid enters the chamber 34 (containing window 52) and turns abruptly at a right angle. The specification in col. 5, lines 61-64 states, "The flow of liquid entering input chamber 34 may be subject to large scale eddying and other disturbances due to the abrupt enlargement of the flow passageway and change in the direction of flow." Also, the Kocher reference shows and describes the Kocher fluid as entering the chamber 36 (containing window 54) and turning abruptly at a right angle. The specification in col. 6, lines 4-12 states, "The flow control portion 59 of window 54 provides a similar function as the active material leaves the active region of the cell. The stream of photons is transmitted through window 54 while the liquid active material flows around the cylindrical portion 60 of the flow control portion of window 54. Any disturbances which may occur in the flow of the active material in the output chamber therefore occur while the liquid is separated from the stream of photons."

The Secondary Chun reference does not even show a liquid host; therefore it

clearly does not show a liquid host flowing through said first lasing chamber in a first direction or flowing and through said second lasing chamber in a second direction. The Chun reference shows a pulsed electrical discharge gas laser. As clearly shown in Figure 1A of the Chun reference and described in the Chun reference specification, a gas is circulated in an oval passage. The Chun specification, in col. 2, lines 28-31, describes the circulation in Figure 1, as, "In FIG. 1, the gas 1 circulates through the device in the direction depicted by arrows 6 so as to flow successively through heat exchangers 7 and the active regions 4 of the device."

The Tertiary Scheps reference does not even show a liquid laser system and clearly does not show a liquid host flowing through said first lasing chamber in a first direction or flowing and through said second lasing chamber in a second direction. The Scheps reference shows and describes a solid state laser not a liquid laser. There is no circulation of a host in the Scheps reference. The Scheps reference specification states, "Numerous crystalline and amorphous materials have been found to be suitable for prisms for intracavity use in a laser" in col. 8, lines 26-28, and "It should be pointed out that prism materials are not restricted solely to solid state materials. Liquid prisms have been used to some extent in the visible region and also in the ultraviolet." The specific embodiments shown in the Scheps reference are solid state prisms and not liquid prisms.

Appellant's claim 1 defines this element at lines 18-23 as "a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host through said first lasing chamber in a first linear direction into said closed loop circulation system and into said second lasing chamber and through said second lasing chamber in a second linear direction into said closed loop circulation system and back into said first lasing chamber, said second linear direction being opposite to said first linear direction."

The American Heritage® Dictionary defines "linear" as: "1. Of, relating to, or

resembling a line; straight. 2a. In, of, describing, described by, or related to a straight line. b. Having only one dimension." Appellant's Drawing Figure 1, Exhibit A, shows the liquid host flowing "through said first lasing chamber in a first linear direction into said closed loop circulation system and into said second lasing chamber and through said second lasing chamber in a second linear direction into said closed loop circulation system and back into said first lasing chamber, said second linear direction being opposite to said first linear direction."

None of the cited prior art references show the.claim elements "a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host through said first lasing chamber in a first linear direction into said closed loop circulation system and into said second lasing chamber and through said second lasing chamber in a second linear direction into said closed loop circulation system and back into said first lasing chamber, said second linear direction being opposite to said first linear direction."

Optical Phase Errors - None of the cited prior art references show the claim elements of optical phase errors are produced by said a closed loop circulation system and "a system for correcting said thermally induced optical phase errors."

The Primary Kocher reference is the only reference that mentions "optical distortion." The Secondary Chun reference and the Tertiary Scheps reference do not mention thermally induced optical phase errors.

The Kocher reference identifies the problem of "optical distortion" but has a solution to the problem that is different from the solution defined by Appellant's claims. The Kocher reference states, "Since the optical distortion of the laser output beam is caused primarily by the unequal liquid velocities in the cell, it appeared that this distortion could be substantially eliminated by creating a more uniform liquid velocity" in col. 2, lines 26-29, and "Large scale disturbance in the active material entering the cell are smoothed while the liquid flows around the flow control means

thereby preventing these disturbances from causing distortion in the output laser beam" in col. 3, lines 16-20.

Trivalent Titanium Ions Dissolved in a Liquid Host - None of the cited prior art references show the claim element "trivalent titanium ions dissolved in a liquid host."

The Tertiary Scheps reference is the only reference that mentions "trivalent titanium ions." The primary Kocher reference and the Secondary Chun reference do not mention "trivalent titanium ions."

The Tertiary Scheps reference states, "Solid state crystalline laser gain elements which are doped with impurity ions for laser operation are highly suitable for this type of laser, as are ion doped glasses or other amorphous materials." The Tertiary Scheps reference only shows systems with solid state lasers, but does state, "It should be pointed out that prism materials are not restricted solely to solid state materials. Liquid prisms have been used to some extent in the visible region and also in the ultraviolet. Since both dye lasers and chelate lasers utilize liquid gain media, this realization extends the utility of this inventive concept to liquids enclosed in a hollow prism as well as solid state laser gain elements." In col 8, lines 55-58, Appellant submits that the Scheps reference does not show enablement of a liquid laser because it does not teach an embodiment with a liquid. Further, the Scheps reference "liquid prism" is not a circulating liquid host containing "trivalent titanium ions dissolved in a liquid host" as defined in Appellant's claims. Further, the Scheps reference "liquid prism" is not described as having "trivalent titanium ions dissolved" therein.

The References Do Not Provide an Obvious Combination - Appellants respectfully submit that the Primary Kocher reference, the Secondary Chun reference, and the Tertiary Scheps reference do not show an obvious combination of claim elements as defined by Appellant's claims within the meaning of 35 USC 103(a). Under MPEP §2142, there are three requirements to establish a prima facie case of obviousness. (1) There must be some suggestion or motivation, either in the references themselves or

in the knowledge generally available to one of ordinary skill in the art, to modify the references or to combine reference teachings. (2) There must be a reasonable expectation of success. (3) The prior art reference (or references when combined) must teach or suggest all the claim limitations. It should be noted that the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on Appellant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Appellants respectfully submit that the rejection fails under the obviousness test. The rejection fails under prong 1 of the obviousness test because there is no suggestion or motivation in the prior art to combine the Kocher reference, the Chun reference, and/or the Scheps reference. Under MPEP §2143.01, "obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art." In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); In re Jones, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). There is no such teaching in the Kocher reference, the Chun reference, or the Scheps reference.

Appellants respectfully submit that the rejection also fails under the second prong of the obviousness test because there is no reasonable expectation of success of the claimed combination. The Kocher reference is directed to a liquid laser systems, the Chun reference is directed to a gas laser systems, and the Scheps reference is directed to a solid state laser systems. To substitute features from the Chun reference gas laser systems or the Scheps reference solid state laser systems into the Kocher liquid laser systems would not have any reasonable expectation of success. The liquid, gas, and solid laser systems are so different the features can not be substituted from one system into another. For example the feature of doping the crystals in the Scheps reference solid state laser systems into the Kocher liquid laser systems would not have a

reasonable expectation of success because doping applies to solids and does not apply to liquids.

Appellants respectfully submit that the rejection also fails under the first and third prong of the obviousness test because only through impermissible hindsight would motivation be found to combine in the Kocher reference, the Chun reference, and the Scheps reference. MPEP §2142 states "the tendency to resort to 'hindsight' based upon Appellant's disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts gleaned from the prior art." Also, under MPEP §2143.01, "the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination." In re Mills, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).

IX. SUMMARY

In summary, none of the three references used in the Office Action show certain significant elements of Appellant's rejected claims. Further, it would not be obvious to combine the three references because the Kocher reference is a liquid laser, the Chun reference is a gas laser, and the Scheps reference is a solid state laser and significant features from such different lasers can not be "obviously" substituted from one reference to another. It is respectfully requested that all of the claims on appeal (claims 1, 3, 4, 5, and 9) be allowed.

Respectfully submitted,

By: Eddie E. Scott

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Date: February 19, 2004

Attachments:

Appendix

Exhibit A

APPENDIX

Claim 1. (previously presented) A laser, comprising:

a laser cavity having

a first lasing chamber,

a second lasing chamber,

trivalent titanium ions dissolved in a liquid host within said first lasing chamber,

trivalent titanium ions dissolved in a liquid host within said second lasing chamber,

a first semiconductor pumping device operatively connected to said first lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber, said first semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber,

a second semiconductor pumping device operatively connected to said second lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said second lasing chamber, said second semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions dissolved in said liquid host within said lasing second chamber,

a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host through said first lasing chamber in a first linear direction into said closed loop circulation system and into said second lasing chamber and through said second lasing chamber in a second linear direction into said closed loop circulation system and back into said first lasing chamber, said second linear direction being opposite to said first linear direction, said closed loop circulation system comprising

a first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said first lasing chamber in said first linear direction and

a second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said second lasing chamber in said second direction that is opposite to said first linear direction.

Claim 2. (canceled)

Claim 3. (previously presented) The laser of claim 1 wherein said closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host includes a pump and a heat exchanger.

Claim 4. (previously presented) The laser of claim 1, wherein thermally induced optical phase errors are produced by said a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host and wherein said first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said lasing chamber in a first direction and said second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out said lasing chamber in a second direction that is opposite to said first direction provides a system for correcting said thermally induced optical phase errors.

Claim 5. (previously presented) The laser system of claim 4, wherein said first portion for circulating said trivalent titanium ions dissolved in a liquid host includes a first flow channel and said second portion for circulating said trivalent titanium ions dissolved in a liquid host includes a second flow channel, said first flow channel and said second flow channel being of substantially equal length.

Claim 6. (canceled)

Claim 7. (canceled)

Claim 8. (canceled)

Claim 9. (previously presented) A laser system, comprising:

an optical cavity having

a first lasing chamber and

a second lasing chamber,

a lasing liquid containing trivalent titanium ions dissolved in a liquid host within said first lasing chamber and said second lasing chamber,

a first semiconductor pumping device operatively connected to said first lasing chamber for optically exciting said trivalent titanium ions dissolved in a liquid host within said first lasing chamber, said first semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions in the 800 to 900 nm region,

a second semiconductor pumping device operatively connected to said second lasing chamber for optically exciting said trivalent titanium ions dissolved in a liquid host within said second lasing chamber, said second semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions in the 800 to 900 nm region,

a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host, said closed loop circulation system comprising
a first portion for circulating said lasing liquid containing trivalent titanium ions dissolved in a liquid host into and out of said first lasing chamber in a first direction, and

a second-portion for circulating said lasing liquid containing trivalent titanium ions dissolved in a liquid host into and out of said second lasing chamber in a second direction that is opposite to said first direction, said closed loop circulation system including a pump and a heat exchanger.

EXHIBIT A

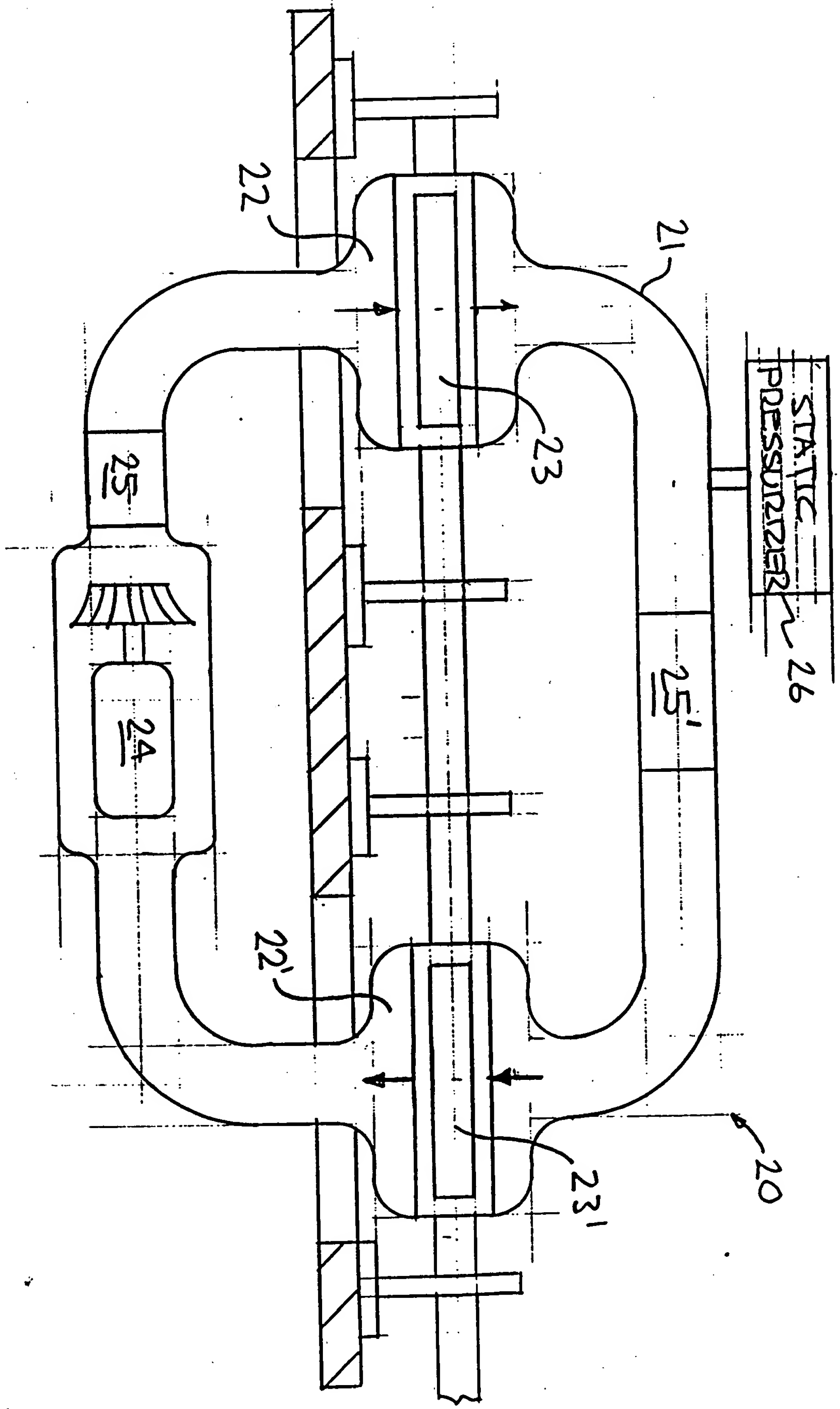

FIG. 1